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# The Correlation of Classical, Jazz, and Pop Music to a Reduction of Dental Anxiety Experienced by Adult Patients

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# The Correlation of Classical, Jazz, and Pop Music to a Reduction of Dental Anxiety Experienced by Adult Patients

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# Abstract

This study explored whether passive music listening caused a decrease in dental anxiety experienced by adult dental hygiene patients and whether there was a difference between genres of music: classical, jazz or pop. This study also looked at the effect of song familiarity and patient music preference on any decrease in anxiety. I worked with sixty adult patients, who were randomly assigned to listen to classical, jazz, pop, or no music at all. Each patient took a dental anxiety survey before and after their teeth cleaning. These surveys were based on the Modified Corah Dental Anxiety Scale. Music was selected from the iTunes highest download charts for each genre. I found that patients not considered to have moderate to severe anxiety had no statistically significant difference compared to the control. However, those with high anxiety who listened to classical music did have a statistically significant decrease in anxiety compared to the high anxiety control group ($p=0.0045$). Song familiarity and patient preference did not have a significant effect on a decrease in anxiety scores. Data was analyzed using single factor ANOVA tests and unequal variance t-Tests. Passive music listening does not have a significant effect on adult dental hygiene patients that have less than moderate dental anxiety. Classical music caused the greatest decrease, and the only statistically significant decrease. This may be because the melodies are accessible to a wide audience, transform throughout a piece, and are typically at a slower tempo than in jazz or pop.

## Acknowledgments

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# Introduction

## Prevalence of Dental Anxiety

Dental anxiety is a prevalent problem for dental patients across the globe, with an estimated 5–7% never or rarely visiting their dentist due to their anxiety and fear.[1] In the United States, it is estimated that 10–20% of adult dental patients are affected by dental fear or anxiety.[2] Although there has been an increase in research into management of dental anxiety and multiple improvements in dentistry and dental techniques, it has continued to remain a prevalent issue in today's public health, with anxiety scores maintaining their stability since the mid-1900s.[2]

## Impact of Dental Anxiety

There have been multiple studies linking dental anxiety to poor health. In one study, patients who experienced dental anxiety had an average of eight to nine decaying teeth, whereas patients who did not struggle with dental anxiety had an average of only one or two.[2] Dental anxiety often leads to a maladaptive and harmful cycle. The anxiety experienced by the dental patient leads to avoidance or postponement of dental examinations or treatment.[2] This delay in dental treatment typically progresses to further dental problems that are much more serious, meaning that they are usually more expensive, invasive, and possibly could result in emergency treatment.[2] These more extreme treatments only serve to maintain or amplify the patient's dental anxiety, thus continuing the damaging cycle. Not only does dental anxiety have a negative effect on oral health, but it also can have a significantly negative impact on a patient's emotional wellbeing.[1] Many times, those patients with severe cases of dental anxiety can be very

difficult to treat, thus resulting in a longer, more negative, and more stressful experiences for both the patient and dental professional.[3]

## Defining Dental Anxiety: Dental Fear, Apprehension, and Phobia

General anxiety refers to an emotional state that occurs before an interaction with a feared situation or object.[3] General fear is described as the specific, or activated, negative response to that situation or object.[3] It is typically found that those people who have a fear of something also experience anxiety about it. Fear and anxiety both involve emotional, behavioral, mental, and physical changes.[3] However, these changes manifest differently in every person. Dental anxiety, an overarching term, is defined as "an abnormal fear or dread of visiting the dentist for preventive care and unwarranted anxiety over dental procedures."[4]

Dental anxiety is often used as an umbrella definition to indicate an unspecific group of dental-related fears. Due to this ambiguity, different patients often need different types of anxiety management techniques and treatment.[1] The umbrella term, dental anxiety, can usually be divided into three different levels of seriousness. The first level is dental fear. Dental fear is the least serious level and involves a typical emotional reaction to objects and situations that may appear threatening in a dental environment.[5] The second level is dental apprehension; this term was chosen to replace the second tier referred to as dental anxiety in Terpack, *et al*, in order to better clarify between the umbrella term and the three tiers. A patient with dental apprehension experiences negative feelings of fear and apprehension before direct interaction or immersion in the dental environment. Dental apprehension typically causes most patients to expect something bad to occur.[5] The third and final level is

dental phobia. Dental phobia is a very serious type of dental anxiety that often causes patients to avoid dental experiences or endure them with extreme discomfort.[5] While many patients experience some level of dental anxiety and fear, only a small percentage will have the clinically diagnosed condition of dental phobia.[3]

As a result of dental anxiety and fear, patients may have a heightened perception of pain and unreasonable expectations of the pain they may experience. This is because pain, while triggered by physiological processes, also is largely impacted by cognitive function and perception.[3] Patients who have dental anxiety or fear may also experience symptoms such as nervousness, feeling threatened, and tension, all triggered by autonomic nervous system activity.[6] Behaviors they may exhibit include shaking, shortness of breath, restlessness, fatigue, and muscle tension. [6]

## Cause of Dental Anxiety

There are many causes of dental anxiety. Early-onset dental anxiety typically develops out of childhood as a result of direct experiences and observation of parental examples.[5] Direct experience references the patient having experienced an uncomfortable or painful dental procedure while they were a child. This experience is usually so negative that it permanently instills a feeling of distrust and fear of dental procedures. Formation of dental anxiety is especially likely to occur if the experience was painful.[5] Observation of parental examples refers to how that patient's parents responded to dental treatments with dental anxiety or fear.[5] As a result of observing this as a child, the patient forms their own dental anxiety.[5] Late-onset dental anxiety typically occurs in adult patients if multiple teeth had been lost to caries (cavities), or they had an above average

amount of dental caries or other dental issues, and therefore more dental treatment, in their adolescence.[2] Developing dental anxiety late in life is particularly prevalent in those patients who use dental health services based on their symptoms, rather than as a preventative measure.[2]

Many specific triggers of dental anxiety have been identified. One study listed seven patient-reported reasons they experience dental anxiety. The most common reason is if the patient has had previous painful experiences.[7] The second most common reason is an apprehension of pain that they believe they will have to endure.[7] A lack of control over the situation, including the inability to stop any uncomfortable or painful treatment, is the third listed reason.[7] Sometimes, if the patient has a general fear of the unknown, not understanding the procedure that is occurring has been cited as a fourth reason for dental anxiety.[7] Interestingly, negative portrayals of dentists in media and negative accounts of dental procedures from friends and family can also impact a patient's dental anxiety.[7] A sixth reason refers to the general countenance of dentists themselves. Many patients have reported receiving depersonalized treatment from detached or distracted dentists can increase dental anxiety.[7] The seventh and final reason is fear of facing judgment or ridicule because of how the patient may react to situations that occur in a dental environment.[7]

Another study listed a few additional causes of dental anxiety. If a patient has a fear of choking, gagging, injection, or the sight or even the thought of blood, there is a higher likelihood they will experience dental anxiety.[3] Other sources of anxiety stem from concerns about being numbed with local anesthetic, low pain tolerance, or a lack of trust in the dental professional. A patient's sense of powerlessness is often enhanced during

dental operations due to the reclined positon of the car.[3] The simple fact that the dentist is inside the patient's mouth also may be a source of anxiety, as some patients perceive this as a breach of personal space.[3]

## Measuring Dental Anxiety

There are both subjective and objective ways of measuring dental anxiety. Objective measurements include blood pressure, heart rate, and respiratory output.[5,8] Subjective measurements include survey questions or picture scales that an observer or the patient fills out.[5] There have been multiple scales developed and tested for quantitating dental anxiety. Corah's Dental Anxiety Scale (CDAS), the Dental Anxiety Scale (DAS), the Modified Dental Anxiety Scale (MDAS), and the Dental Fear Survey (DFS) have all been tested and proven to be reliable.[9,10]

The DAS was one of the first scales used to assess dental anxiety. The questions use a ranged answer scale from "calm" at 1 to "very anxious" at 5, with total scores from 4 to 20.[10]In studies using the DAS, a median-split procedure is used to determine a cutoff between moderate and severe dental anxiety.[10] The average score for general dental patients has been determined to be 7.3 to 8.7.[8] A similar scale, the MDAS, is most commonly used in dental anxiety research. It is a five-item questionnaire with a five-point scale response for each question.[9] The responses range from "not anxious" at 1 to "extremely anxious" at 5. The higher the score, the higher the perceived dental anxiety. Based on many studies, a score of 19 has been suggested as a marker for high dental anxiety.[9]

A third scale, CDAS, was developed by Dr. Norman L. Corah and has been found to be a reliable survey for dental research projects and is often used in dental offices to measure anxiety.[11] This scale is very similar to MDAS. The CDAS answers range from "relaxed" at 1 to "so anxious that I sometimes break out in a sweat or almost feel physically sick" at 5.[11] Each answer is given a numerical value and added for a possible 20 points. This scale rates scores of 9-12 as moderate anxiety, 13-14 as high anxiety, and 15-20 as extreme anxiety (phobia).

A different approach to categorizing anxiety, the DFS, takes data from behavioral, physiological, and cognitive information about specific dental procedures and treatments based on self-reports.[12] Multiple studies have shown DFS to be a reliable and valid dental anxiety measurement tool.[12] Each question has a numerical line for the patient to indicate their fear or anxiety. Questions included involve the fear level experienced when they approach the dentist's office, see the dentist, see and hear the drill.[12] The physiological questions include their level of nausea and perspiration when having dental work done.[12]

## Physiological Effects of Music

Music has been shown to have many benefits to those listening. On a neurological level, music reduces anxiety by interacting with the body's sympathetic nervous system, a part of the autonomic nervous system.[13,14] The sympathetic nervous system is responsible for initiating the fight-or-flight response, as well as fear and anxiety. Specifically, music has been shown to suppress the actions of the sympathetic nervous system, leading to decreased secretion of epinephrine and norepinephrine, as well as decreased muscle arousal.[13] Cortisol is a hormone that is released from the adrenal glands

on top of the kidneys in response to stress. There has been research demonstrating that music listening decreases production of cortisol, thus indicating music decreases stess.[13] Music also causes the part of the brain called the limbic system to release endorphins, enhancing feelings of well-being. Studies involving neuroimaging have shown that music stimulates the nucleus accumbens, an important pleasure center in the brain located in the hypothalamus.[13] The hypothalamus regulates body temperature, hunger, thirst, fatigue, relational behaviors, and the release of hormones related to emotions. The stimulation of the nucleus accumbens causes dopamine to be released. Dopamine is a neurotransmitter, meaning that it signals other nerve cells to release various chemical substances, including the aforementioned epinephrine. Through signaling the release of these other substances, dopamine influences mood and pleasure. Music has furthermore been shown to suppress the activity of the amygdala, an adjacent part of the limbic system that develops and activates conditioned fear responses.[13] Music's combination of stimulating the nucleus accumbens and suppressing the stimulation of the amygdala make it an important tool for anxiety and pain management.

On a cognitive level, it has been theorized that music distracts patients from stimuli that could cause pain and therefore amplify an anxiety response.[13] In regard to pain suppression, it is believed that music interacts with the *Gate Control Theory of Pain.*[5,15,16] This theory states that the afferent nerves that carry pain stimuli to the brain can only carry a certain amount of information.[5,15,16] Music can block this pain pathway by taking up some of the space available to transmit pain, therefore decreasing the amount of perceived pain.[13,14] Psychosocially, music can provide an experience that may ease anxiety and comfort patients before and during dental procedures.[13] If the volume of

the music is loud enough, it can even block unpleasant sounds of the dental environment that may trigger anxiety.[14] One article stated that music allows a person to synchronize their rhythms with the rhythms vibrating around them.[17] Therefore, an anxious patient could potentially slow down a racing heartbeat by listening to music with a slow tempo. The fast heartbeat would slow down to synchronize with the music's slow rhythm.[17]

## Music as an Anxiety Reducing Technique

There are multiple ways in which music can be used to reduce anxiety in a dental office setting. The first way is typically referred to as musical listening, which is initiated by the patient.[13] The second way is music medicine. This refers to the use of prerecorded music that the medical or dental professional offers to manage anxiety.[13] The last way is when a professional music therapist provides individualized sessions of music listening and interventions.[13]

Music medicine employs the use of music distraction. Music distraction is a technique in which patients listen to music during stressful events or procedures.[18] Music distraction can be defined as "a noninvasive technique in which the patient listens to pleasant music during a stressful procedure."[9] This distraction technique also has the added benefit of limiting the amount of sound typically heard in a dental environment that may trigger anxiety.[9] Studies have shown that the higher the level of attention required for the task at hand (i.e. the distraction tool), the higher likelihood that there will be a positive effect on anxiety.[1]

When determining the efficacy of music distraction on anxious patients, there are multiple aspects that should be considered. Age, gender, and culture affect how patients

will respond to music distraction because of patient preference. The music is not selected by the patient, but instead by the dental practitioner or a researcher, and therefore the music selected may be biased toward the selector's preferences. These preferences may not match the preferences of someone in a different age range, of a different gender, or from a different culture. The level of anxiety also has an important impact on how patients will respond to music distraction.[13] Other factors to be considered include emotional state, cognitive interpretation of music, and the feelings and images that the music invokes for each specific patient.[13] Certain aspects of the music must also be taken into account in order for music distraction to be effective. The type of music, volume, and length of exposure should all be considered.[15] Many studies have indicated that a key factor in the effectiveness of music distraction to reduce anxiety is the patient's familiarity and preference for the music.[8,13,14]

Recently, a particular interest in treating dental anxiety with music distraction has developed. This is primarily due to the negative aspects of another dental anxiety reducing technique, conscious sedation. Conscious sedation includes inhalation of nitrous oxide, intravenous sedation, or oral sedation.[19] Not only do these methods have possible negative side effects and risks, but they also increase the cost of dental visits.[13,15,19] Due to these potential issues, patients who have dental anxiety have been shown to prefer non-pharmacological interventions.[13,20] Music distraction is particularly attractive to both patients and dental professionals because it is easy to administer and relatively inexpensive.[15]

## Need for Study

Several studies have addressed the effectiveness of various anxiety interventions on adult dental patients. However, breadth of research is lacking, and many studies find conflicting results due to a non-standardized scale to measure anxiety. Even less research has been conducted on the effectiveness of music listening to limit anxiety felt by dental patients. Many related studies address this relative lack of research,[1,2,14] as well as the difficulty of interpreting the data from these studies.[1] In addition, there are many conflicting studies, as well as studies with inconclusive findings.[1] Studies with supporting data regarding the positive anxiety-reducing effects of music include Klassen, Liu, Bare, and Mejía. From these studies Klassen determined that music alone only has a minimal effect on moderate cases of dental anxiety and should instead be used in combination with other dental reducing techniques. Studies with data not supporting this theory included Aitken and Kim. Inconclusive studies included De Jongh, and Lahmann.

Many studies suggest that the length of time patients are exposed to music affects the outcome of anxiety changes.[14] One study suggests 20–90 minutes of music is adequate.[21] The use of an adequate control with parameters similar to the music intervention are also suggested in future studies.[15] Many studies discussed the impact on anxiety based on selection of pre-determined music versus music picked by the patient.[13,14] From the available studies involving dental anxiety and music distraction, only a few listed the music genre or song(s) they used, with still fewer comparing different types of music.[15] One study suggests that the music used be a slow tempo, have repetitive rhythms, "gentle contour," and use string instruments.[19] Others cited specific pieces of classical music such as Ravel's *Introduction and Allegro for Harp, Flute, Clarinet and String Quartet* and J.S. Bach's "Aria," although the study did not specific

the specific aria.[6,7] Some genres that various studies have suggested, but not tested against each other, include classical (in the broader definition of the genre, not the specific time period),[7] soft-rock,[7] soothing music,[14] pop,[14] country,[14] easy-listening music,[21] sedative music (which the study specified as Buddhist chants),[21] subject-preferred music,[21] and rhythmic music such as Dan Gibson's "Solitudes: Exploring Nature with Music."[16] From one article with more musical, instead of medical, perspective it was suggested that the music used have harmonic consonance, absence of percussion, and predictable dynamics.[22] The article also suggested that the music be of the baroque or classical styles, or have a relaxing, meditative quality found in the music of Debussy or Vanghelis.[22]

The conflicting results of various studies, as well as the general lack of study of music distraction's effect on reducing dental anxiety, demonstrates a need for a more structured study. The absolute lack of data on the effects of different genres of music on anxiety calls for this present study. I believe that determining the music genre, if any, that best reduces anxiety in adult dental patients offers an accessible way for dental practitioners to provide a more enjoyable and comfortable dental experience. Due to the negative impacts of dental anxiety on overall dental health, making dental experiences for patients more enjoyable could potentially help boost the overall dental health of a population.

# Methods and Materials

## Music Determination

I determined the specific music tracks for each genre by consulting iTunes charts and song sales. This was done with the intent to control the variable of familiarity for the

patients. By selecting the top songs, patients had a similar chance of recognizing the songs from all three genres. On January 25, 2017, I collected the top one hundred songs for the genres of pop, classical, and jazz music. When the same song appeared on the list more than once, having been performed by different artists, the top-selling version was chosen.

Many of the songs on the classical top-100 list were removed. Any songs that were a cover of a pop song but performed on classical instruments were removed, such as many songs by The Piano Guys. Songs that were exclusively used for background music for commercials or movie soundtracks were also removed, such as *Nuvole Bianche* by Ludovico Einaudi. Any songs that contained vocals were removed to further differentiate between pop (all vocal), jazz (combination of instrumental and vocal), and classical (all instrumental). The remaining classical songs were then selected in order from proximity to number one until the time goal (seventy minutes) was reached.

The top one hundred jazz songs required the least amount of processing. Only duplicates of songs, such as the same song appearing on two different tribute albums, were removed. Although it can be argued that songs on the list fall into many genres related to jazz, such as blues and soul, I decided to adhere to the iTunes classification. This was a way to eliminate bias in relation to personal musical taste or definition that could potentially affect my results. Songs from the jazz list were added starting at number one and ending when the time goal was met.

For the pop top-100 list, all the songs were included, except for "Play That Song" by Train. I chose to remove this song because it is a cover of the popular folk song "Heart and Soul." If any of the songs were explicit, a censored radio version was selected instead in order to assure that the music would not cause any of the patients discomfort. The music selected for each category was put on a CD for the patients to listen to. Since each standard CD holds approximately seventy minutes of music, songs were added starting at number one until the time goal was met.

Some preliminary comparisons were made to determine distinct and measurable differences between the three genres. The tempo of each song on each list was taken by using a metronome and aurally recording the beats per minute (bpm). I determined that the average beats per minute of each genre did not vary significantly, as seen in Figure 1.

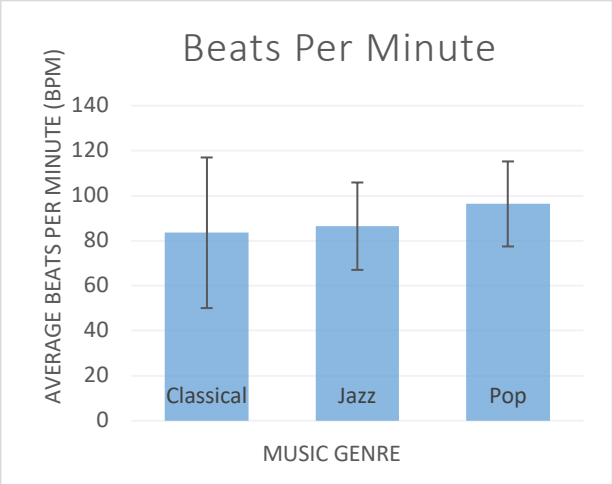


**Figure 1.** Average Beats Per Minute. Classical bpm average: 84, standard deviation: ± 33.5; Jazz bpm average: 86, standard deviation: ± 19.4; Pop bpm average: 96, standard deviation: ± 18.9.

The classical average was 84 bpm, jazz average was 86 bpm, and the pop average was 96 bpm. A two-sample unequal variance t-Test was used to determine if there was a statistical difference in bpm. It was determined that there was no statistical difference between the average bpm of the three genres ($p > 0.05$). The time duration of each song in each genre was recorded and the averages compared, see Figure 2. The average length of the classical songs was 5 minutes and 10 seconds. The average length of jazz songs

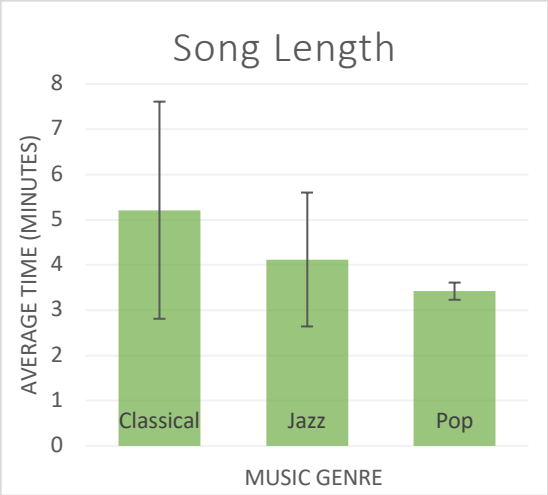


**Figure 2.** Average Song Length. Classical average: 5 min 10 sec, standard deviation: ± 2 min 16 sec; Jazz average: 4 min 11 sec, standard deviation: ± 1 min 49 sec; Pop average: 3 min 42 sec, standard deviation: ±

was 4 minutes and 11 seconds. The average length of pop songs was 3 minutes and 42 seconds. Pop music also had the least variation in individual song times. I employed a second two-sample unequal variance t-Test to determine if there was a statistical difference in song lengths. I determined that there was a statistically significant difference in song length only between classical and pop music. ($p = 0.02$). Both the aspects of beats per minute and song length will be considered during data analysis and discussion of results.

## General Procedure

I collected data at the dental practice of Melissa A. Jarrell, D.D.S., Family and Cosmetic Dentistry of Kokomo during the months of May through August 2017. Every patient was approached while in the waiting room and asked if they would like to participate in a study that may make their dental cleaning more comfortable and enjoyable. I also made them aware of an incentive to participate, which was a raffle to win a gift card to a local restaurant. If they agreed, the participants were then asked to complete a five-question entry survey designed to take no longer than two minutes (see Appendix A).

As the patient went into the cleaning, they were given a CD player and headphones with a predetermined CD. The CD players used in this study were ONN™ brand and had FM radio capabilities. The headphones used were iFrogz® Ear Pollution Toxix brand stereo headphones. Each CD contained approximately seventy minutes of either jazz, pop, or classical songs. I showed the patients how to adjust the volume and made them aware that they could choose to stop participating at any time. They were not allowed to skip songs, and patients therefore listened to the song lists in the same order. Patients were also asked to begin listening to the music as the hygienist began the cleaning. A dental cleaning usually takes around thirty minutes, so it was expected that there would be music on the CD that the patients would not hear. By placing the songs highest on the iTunes sales list first, the patients had a maximized chance of recognizing the songs they heard.

When the patient was finished having their cleaning, I asked them to hit the pause button so that the song they ended on could be recorded. Then they filled out a seven-question exit survey and returned the CD player and headset. The control patients went through a similar procedure, but did not have a CD in their CD player. Their entry survey was unchanged from the experimental groups' surveys (see Appendix C). Their exit surveys were modified since they did not actually listen to any music, making it two questions shorter than the experimental group's exit surveys (see Appendix D).

## Dental Anxiety Survey

The entry survey used in this study is primarily based off of the Corah's Dental Anxiety Scale (CDAS). Since this study only considers anxiety of adult dental cleaning

patients, questions relating to tooth drilling and anesthesia injections were removed. The questions taken directly from the CDAS include prompts about the anxiety they experience while waiting in the chair to get their teeth cleaned, as well as the anxiety felt as the hygienist gets out their tools.[9,10] To account for research demonstrating that sound can trigger dental anxiety,[14] a question was included determining anxiety experienced at the sound and feeling of scraping. Patients were also asked if they were planning to receive any other dental work the same day as their teeth cleaning. This question was included in order to eliminate a variable, since the knowledge of a procedure after a teeth cleaning could skew the patient's answers to the anxiety portion of the survey. The music portion of the entry survey involved music preference of patients, since research has shown that patient preference and familiarity plays a role in music's anxiety-reducing affects.[13,14] Sequential age ranges were included so patients could input their age in order to determine if it had any effect on music preference, dental anxiety, and effectiveness of the music distraction.

After the patients were finished with their dental cleaning they were asked to fill out a seven question exit survey that should take no longer than three minutes (see Appendix B). The exit survey was meant to mirror the entry survey as close as possible to narrow in on the single variable of music genre. In order to do this, the questions were modified to be past tense and include the phrase "while listening to music." An additional question was included about learning if any post-cleaning procedures were needed, as this could affect their answers on the anxiety portion of the survey. Participants were also asked to report whether they turned the volume down or off at any time, as this could affect the results. The music portion of the exit survey served as a way to measure the

how familiar each patient was with the music genre found on their CD. This music portion was used to determine if patient preference and familiarity had a significant impact on the music's ability to reduce anxiety. The answer options for this question were given numerical values and ranged from "recognized none of the songs" at 1 to "recognized all of the songs" at 5.

I designated every tenth participating patient as a control who did not listen to the music, but wore the headphones, as well as filled out both the entry and exit surveys. These surveys were slightly modified by eliminating the music portion of the surveys, since the control patients did not listen to music (see Appendices C and D). The control exit survey also eliminated the phrase "while listening to music." By removing this phrase, the control entry and exit surveys mirrored each other in the same way the experimental group entry and exit surveys did.

The responses recorded on each survey were assigned a numerical value based on a pre-existing and widely accepted dental anxiety survey scoring system, CDAS.[9,10,11] "Relaxed" was given a value of 1 and continue through "Very Anxious," which was given a value of 5. Since there were three questions, each with a maximum value of 5, the total possible value was 15. In CDAS the anxiety ratings are based on a total value of 20. In order to account for this discrepancy, new ranges were extrapolated from the ranges based on the 20-point scale.

## Statistical Analysis

I first considered each genre independently to see if there was a statistically significant decrease in the amount of anxiety felt in comparison to the control patients

using a two-sample unequal variance t-Test. The three genres were then compared to one another to determine if one specific genre showed a higher decrease in anxiety experienced in relation to the control using a single sample ANOVA test. Each genre was then compared to each other to determine if there was a statistically significant difference in the relative decreases in anxiety for each genre, using a two-sample unequal variance t-Test. The relative changes in anxiety for each genre were compared to each patient's familiarity with the songs they heard in each genre to determine if being familiar with the music had any significant impact on decreasing anxiety.

# Results

## Anxiety Change Experienced Per Question

Question 1 on the anxiety portion of the entry survey asked each patient to indicate their level of anxiety when they are waiting in the office for their appointment. The average indication was 1.54. The second question asked each patient to indicate their anxiety level when seeing the hygienist get out all their tools. The average score was 1.72. The third question asked about the patient's anxiety related

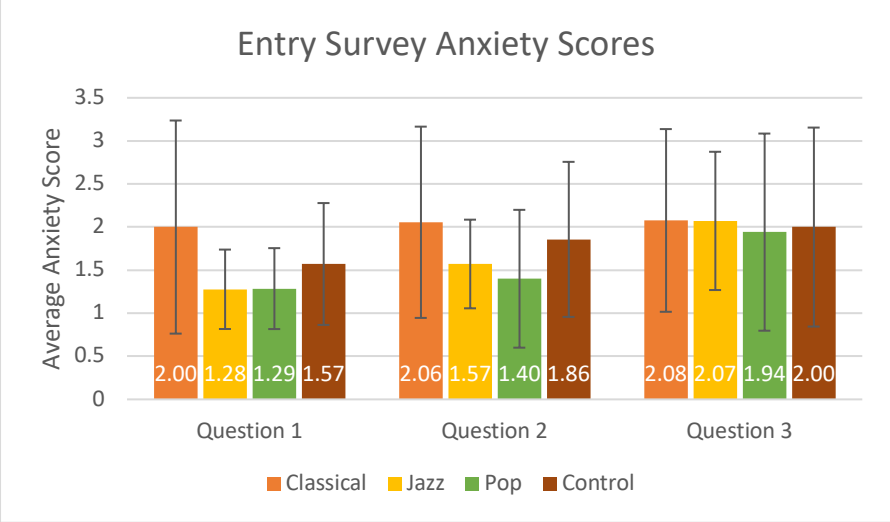


**Figure 3.** Average entry survey scores for each genre corresponding with the first three questions relating to anxiety. Question 1 average was 1.54, Question 2 was 1.72, and Question 3 was 2.02.

with the sound and feeling of having their teeth scraped by the hygienist. The average score was 2.02, which was an increase from "relaxed" to "a little uneasy." The average scores were all under moderate or severe anxiety indicators.

The exit survey's anxiety portion had the same three questions, but added "while listening to music" at the end. The control group's exit surveys simply posed the questions in past tense. The average for the first question was 1.26, the average for the second question was 1.31, and the average for the third question was 1.49. Therefore, all the average exit survey scores fell into the "relaxed" category.

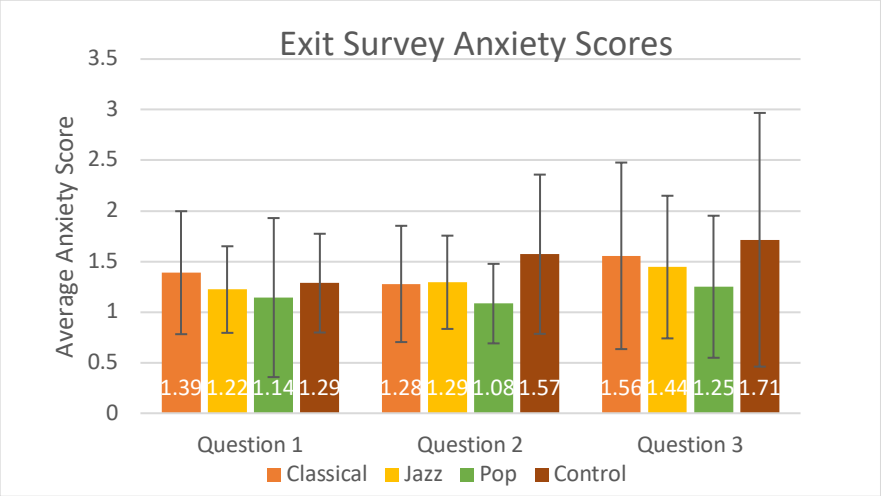


**Figure 4.** Average exit survey scores for each genre corresponding with the first three questions relating to anxiety. Question 1 average was 1.26, Question 2 was 1.31, and Question 3 was 1.49.

## Anxiety Change Experienced Overall

Patients listening to classical music experienced an average decrease in anxiety score of 1.91. Those listening to jazz experienced a decrease of 0.96, and pop-listeners experienced a decrease of 1.15. The control group also experienced a decrease in anxiety score of 0.86. This is a possible indication that there is a reduction in anxiety experienced simply because the cleaning procedure is over. A single-factor ANOVA test was used to determine if there was a statistically significant difference in anxiety score changes

between the three genres and the control group. In spite of the overall decrease experienced by all groups, there was not a statistically significant decrease in anxiety for the three genres compared to the control ($p > 0.05$).

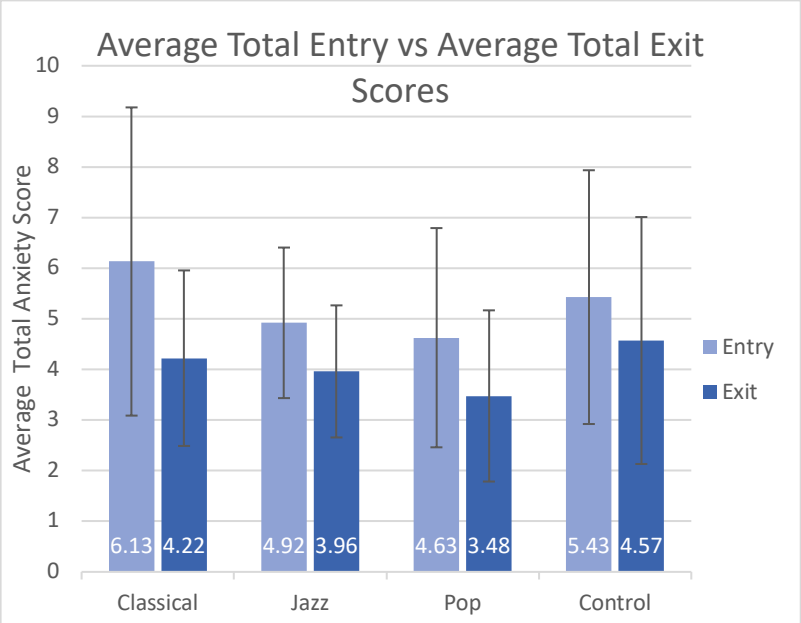


**Figure 5.** Difference between average entry and exit scores for each test group. For classical music: average entry score was 6.13 ± 3.04, average exit score was 4.22 ± 1.73. Jazz music: average entry score was 4.92 ± 1.49, average exit score was 3.96 ± 1.30. Pop music: average entry score was 4.63 ± 2.17, average exit score was 3.48 ± 1.69. Control: average entry score was 5.43 ± 2.52, average exit score was 4.57 ± 2.44.

Next, I used a two-sample unequal-variances t-Test to determine if there was a statistically significant difference in anxiety score decrease between each of the genres. Even though the average decrease in anxiety had a different value for each of the three genres , there was not a statistically significant difference ($p > 0.05$). These findings support related studies that found that passive music listening was at most a placebo effect on the anxiety of dental patients.[8,13, 18] However, it is also mentioned in these studies that patients with medium to low anxiety scores do not respond to passive music listening as well as high anxiety scoring patients.[13,15]

The average dental anxiety score before the procedure began for patients in this study ranged from 4.6–5.9 on a scale of 15. The reported global average dental anxiety score of general dentistry patients is 7.3–8.7 on the Dental Anxiety Scale (DAS), which

has a maximum score of 20.[8] On the 15-point scale used in this study, the global average would be extrapolated to 5.475–6.525. Therefore, it can be concluded that the patients of this study would be categorized below the global average. The DAS also rates scores of 9–12 as moderate anxiety, 13–14 as high anxiety, and 15–20 as extreme anxiety (phobia).[11] By extrapolating these categorizations on a 20-point scale to the 15-point scale used in this study, 7–9 is considered as moderate anxiety, 10–11 as high anxiety, and 12–15 as extreme anxiety (phobia). The average of this study (4.6–5.9) therefore is below what is considered moderate anxiety. The outcomes of this study resemble the research of Kim, Bradt, Klassen, and Aitken, who determined that music does not have a significant impact on decreasing anxiety, especially in patients without high dental anxiety.

Interestingly, when only patients with moderate to high dental anxiety were considered, there was a statistically significant difference found in relation to the control group. Patients who listened to classical music were found to have a statistically significant decrease in anxiety compared to the control group ($p = 0.005$). A two-sample unequal-variances t-Test was used to determine this difference. Therefore, I can conclude that patients with moderate to high dental anxiety do experience a significant decrease in anxiety when listening to classical music. This does, however, warrant additional study, particularly focusing on groups that fall into the moderate to high dental anxiety scale, as my study dealt primarily with patients in the low to moderate dental anxiety ranges.

Influence of Familiarity and Preference

The patients that listened to classical music had an average song familiarity score of 2.89 out of 5. Those who listened to jazz had an average score of 3.56, and those that listened to pop had an average score of 3.24. Despite jazz having the highest average familiarity score, those who listened to this genre had the lowest difference in pre- and post-anxiety scores (0.96), only higher than the average difference between the control group's pre- and post-anxiety score (0.86). Those who listened to the classical genre recognized the music the least but experienced the greatest reduction in anxiety scores. Therefore, the level of familiarity with the music being listened to does not appear to correlate with a greater reduction in anxiety scores. The lack of familiarity actually tends to correlate with a greater decrease in dental anxiety. It is important to note that the studies that claim familiarity of music has a potential impact on the relative reduction in anxiety also assume this familiarity is generated through the patient being able to choose their own music and choosing songs they are familiar with.

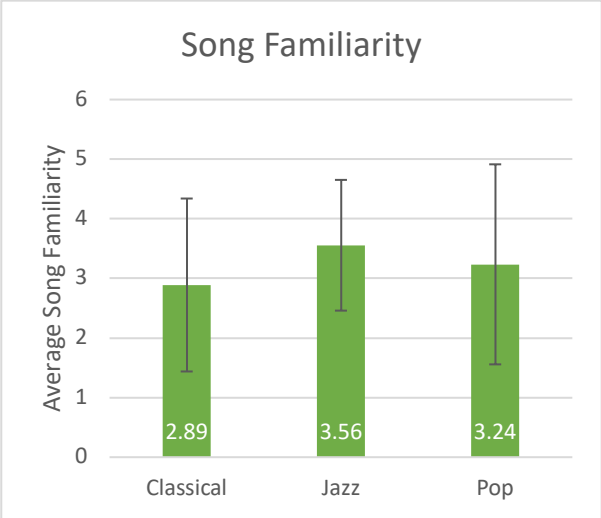


**Figure 6.** Average song familiarity for each genre. Recognizing no songs was a score of one, recognizing all songs was the maximum score of five. Classical average: 2.89 ± 1.45. Jazz average: 3.56 ± 1.10. Pop average: 3.24 ± 1.68.

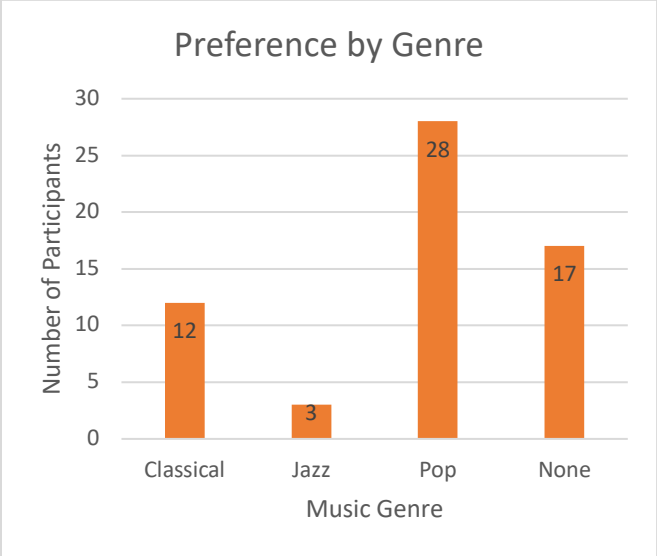


**Figure 7.** Preference of genre out of the four options. 12 of the 60 total patients chose classical, 3 chose jazz, 28 chose pop, and the remaining 17 chose that none of those genres were preferred.

Patient preference was also looked at to determine if there was any correlation to a greater decrease in anxiety. Only 12 out of 60 total patients indicated that classical music was the genre they prefer over jazz or pop music. Out of those 12, 4 were randomly assigned the classical genre. Out of those 4, only 1 patient had a decrease in anxiety. Interestingly, this decrease was fairly steep (4 points). For jazz music, only 3 patients indicated they prefer to listen to jazz over the other options, and all 3 were randomly paired with jazz music. Only 1 of the three experienced a decrease in anxiety (2 points). As for pop music, 28 patients indicated they listen most to that genre over the others; 8 of those patients were randomly paired with pop music. Of the 8 patients, 6 experienced a decrease in anxiety (ranging from 2-3 points). Despite pop music indicating the highest decrease in anxiety when patients listened to the genre they were most familiar with, those patients experienced a smaller decrease in anxiety on average than patients who listened to classical music. Therefore, it is inconclusive to state that playing music from the genre that patients most listen to will significantly impact the relative decrease in dental anxiety.

It is interesting to note that on the exit anxiety surveys 7 patients who indicated they did not prefer to listen to the genre they were assigned did indicate in a later

question that they the genre they typically listen to was in fact the genre they were assigned. This is most likely due to confusion over the intended meaning of those two questions. Out of those assigned to the classical genre 4 did this, and out of those assigned to the jazz genre 3 did this. This is most likely due to ambiguity in wording and lack of clear understanding of the question about the genre they listen to the most (referred to as patient preference) and the question about if they typically listen to that genre. The latter question was a "yes/no" format and to not cause a bias, any questions about further clarification were not answered. Many patients who indicated they most listened to none of the genres in this study would also write the genre they do most listen to. These tended to be country music, rock music, or contemporary Christian music.

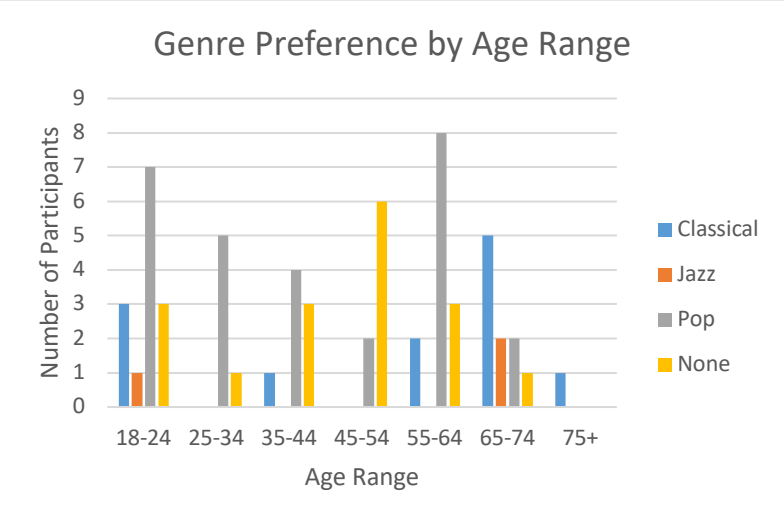


**Figure 8.** Preferred genre by age range. Pop was the most preferred genre of all age ranges, except 45-55 which preferred none, and 65-75+ that preferred classical.

Figure 8 displays patient preference by age range. Pop music was the preferred genre for most age groups, with only those who fell into the 45-54 group indicating none, and those who fell into the 65–74 group indicating classical music. The only patient in the 75+ group indicated they preferred classical music. The genres were assigned to each patient based on a rotating order of classical, jazz, and pop music, with every tenth patient serving as a control. Therefore, the

distribution of genres by age range was random, as indicated in Figure 9. The 18-24 age range did not have a control, and the 75+ age range only had jazz music, but all other age ranges had at least one of each group.

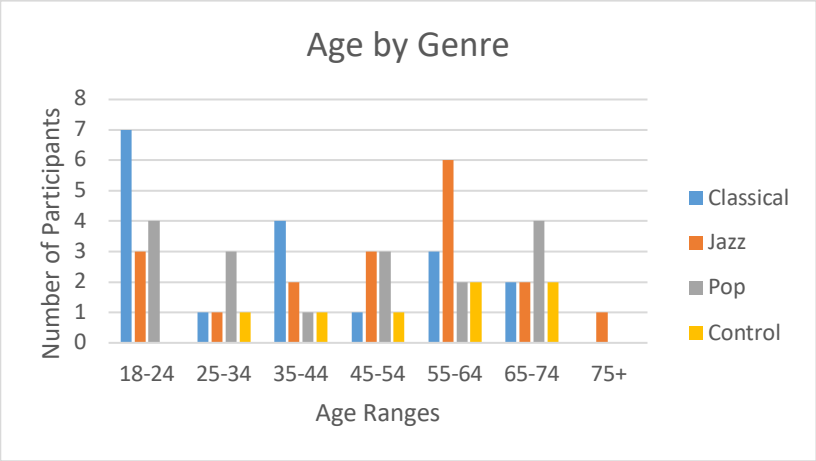


**Figure 9.** Distribution of age by genre. The genres were assigned in a set order regardless of patient age, anxiety level, or music preference.

## Track Reached by Genre

As expected due to the difference in average song length per genre, the jazz and pop genres reached the highest track numbers. Jazz reached track 8 on average and pop reached track 9 on average. However, the classical genre only reached track 4 on average. Therefore, those listening to the classical CD on average only listened to half the amount of songs that those listening to jazz and pop reached

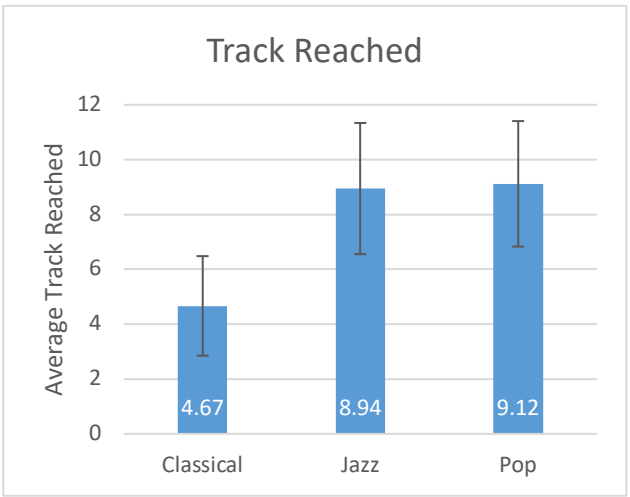


**Figure 10.** Average track reached by genre. Classical average: 4.67 ± 1.81. Jazz average: 8.94 ± 2.39. Pop average: 9.12 ± 2.29.

on average. This did not, however, seem to have an impact on lowering anxiety, as classical music had the relative highest decrease in dental anxiety scores.

## Distribution of Age by Genre

Before comparing the age ranges represented in this study, it is important to consider the general demographic profile of the city in which the research took place, Kokomo, Indiana. The 2010 United States census for Kokomo, Indiana, listed the following percentages for each age range: those age 15-19 represented 6.3% of the total population, 20–24 represented 6.3%, 25–34 represented 13.4%, 35-44 represented 11.8%, 45–54 represented 14.1%, 55-64 represented 12.1%, 65–74 represented 8%, and 75+ represented 7.8%.

Upon comparing the ages ranges of patients receiving teeth cleanings it was apparent that two ranges were under represented. The first of these age ranges was 25–34 years old. This is likely due to issues regarding health and dental insurance. Most young adults stay on their parent's insurance until they are 26 years old. After that dental health is often put to the side if dental insurance is not included in work benefits. Typically, these benefits are not included in most entry level jobs. In a 2014 survey, 43% of those who were uninsured indicated that the cost of dental procedures was the primary reason they did not visit the dentist.[23] It is interesting to note that this age range had the second largest population percentage (13.4%) of the age ranges included in the study for the city of Kokomo.

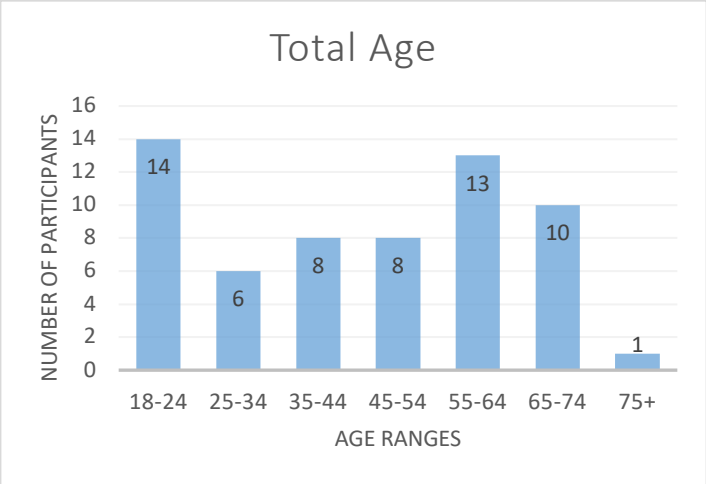


**Figure 11.** Total patient pool categorized by age range. A total of 60 patients participated in this study.

The second age range that was underrepresented was the 75+ age range. This is most likely because at that age many dental patients do not retain their original teeth and instead opt for dentures. Those that have dentures do not typically come in for cleanings. In the same 2014 survey, 29% of patients who were 65 and older indicated that having dentures or no teeth was the primary reason they did not visit the dentist.[23] Dental insurance may also play a role, as those who are 75 and up typically are retired and may not have insurance. Due to this lack of insurance the cost of potential dental care tends to drive older patients away.[24] The availability of transportation to and from the dental office is another concern often brought up by elderly dental pateints.[24] A third reason for this lack of representation is that those age 75+ only make up 7.8% of the population in Kokomo, one of the lowest population groups.

The highest represented age group was 18–24 year olds. This is likely due to the fact that these patients are still covered by their parent's insurance and are regularly encouraged to go to teeth cleanings by their parents. There were many children under the age of 18, but they were not included in this study as they are minors. Aside from the 18–24 age range, the trend in ages resembled a bell curve, with 25–34 and 75+ being very low, 35–44 and 65–74 being in the middle, and 45–54 and 55–64 being highest.

# Discussion

## Effect of Post-Cleaning Procedures

Out of 60 total patients, only two who indicated that they learned they needed a dental procedure after their cleaning had an increase in dental anxiety score instead of a decrease. Eighteen total patients learned they needed a dental procedure, five of those patients already knew this going into the dental cleaning. However, the knowledge of a post-cleaning procedure did not seem to affect the vast majority of patients in this situation. Besides the two aforementioned patients, the other sixteen had a decrease in dental anxiety score, or they indicated the lowest total anxiety score (3) and it did not increase.

This study only excluded the results from one patient, who had disclosed that they were partially deaf and that the headphones interfered with their hearing aid, thereby affecting the testing outcome. One other patient, who listened to jazz music, had an increase in anxiety score of one point and did not indicate that they needed a post-cleaning dental procedure; therefore, it is unknown why this patient's anxiety increased.

## Practical Implications

The results of this study can be potentially implemented in many dental office settings. Many dental offices already contain sound systems, televisions, and even personal listening devices. Dental offices could easily play certain genres of music over the sound system to assist in the relief of dental anxiety experienced by their patients. This study found that classical music caused a statistically significant decrease in dental anxiety experienced by patients with moderate to severe anxiety. Therefore, classical

music could easily be played throughout the dental office in order to achieve the desired effect.

## Patient Receptiveness

Most patients were very receptive to participating in this research. Many commented on the survey question pertaining to the music genre they most listened to out of classical, jazz, and pop. A few patients even wrote in a music genre as well as checking the box indicating they listened to none of the indicated genres. There also seemed to be some confusion about the question pertaining to whether the patient turned down or muted the music during their cleaning. It seemed that many patients indicated they turned down the music even if it was only to adjust the volume to their comfort level. The question was meant to indicate if they had stopped listening to the music at any time. Because of this, those surveys in which the patients indicated they turned down the music will not be included in the group with those who muted the music or took off their headphones during their cleaning. Only one patient indicated they muted the music; they also learned they needed a post-cleaning procedure and were one of three patients whose anxiety scores slightly increased from the entry to exit surveys.

The majority of negative comments that were received came from those listening to the classical music CD. A few patients indicated that they thought the music was "elevator music" and others told me after their cleaning that they did not like classical music. These patients tended to fall in the middle-aged adult age ranges. No one in the jazz and pop groups indicated they disliked the music. Young to old patients indicated to

me that they enjoyed certain songs and the music overall from the jazz and pop groups, even if they did not typically listen to those genres.

## Limitations of Study

### Low-Anxiety Scoring

One limitation of this study was the use of only dental hygiene patients. Typically, these patients experience less anxiety than patients undergoing more invasive dental procedures. Dental hygiene patients also come in every six months to have their teeth cleaned and checked. This reoccurring exposure to the dental environment may contribute to lower anxiety indicators.

### Music Genres

This study chose the three genres based on those most frequently looked at in related studies. However, a potentially more successful approach would be surveying the patients on their most listened to genres before the study and then choosing the top three genres. This would provide a better indication of whether or not song familiarity and patient choice impacted any decrease in dental anxiety. The idea brought up in many studies concerning a potential added decrease in dental anxiety when patients choose their own music is a factor this study did not directly consider.

## Conclusion

This study found that patients with low dental anxiety did not experience a statistically significant decrease in dental anxiety compared to the control group. However, when patients with only moderate to severe dental anxiety were considered, there was a statistically significant difference between those who listened to the classical genre and the control group. Patient preference and song familiarity did not appear to have any significant impact on a decrease in anxiety.

# Appendix A

**Entry Survey**

1.) Indicate your age:

| | | | | | | |
|---|---|---|---|---|---|---|
| 18-24 ☐ | 25-34 ☐ | 35-44 ☐ | 45-54 ☐ | 55-64 ☐ | 65-74 ☐ | 75 + ☐ |

2.) When you are waiting in the dentist's office for your turn in the chair, how do you feel?

| | | | | |
|---|---|---|---|---|
| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |

3.) Imagine you are in the dentist's chair about to have your teeth cleaned. While you are waiting and the hygienist is getting out the instruments which will be used to scrape your teeth, how do you feel?

| | | | | |
|---|---|---|---|---|
| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |

4.) What is your level of anxiety in relation to the sound or feel of scraping during teeth cleaning?

| | | | | |
|---|---|---|---|---|
| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |

5.) Will you be having another dental procedure today after your cleaning?

| | |
|---|---|
| Yes ☐ | No ☐ |

6.) Which of these music genres do you most often listen to?

| | | | |
|---|---|---|---|
| Classical ☐ | Jazz ☐ | Pop ☐ | None of these ☐ |

**Exit Survey**

1.) When you were in the dentist's chair having your teeth cleaned while listening to music, how did you feel?

| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |
|---|---|---|---|---|

2.) While you were waiting and the hygienist was getting out the instruments which would be used to scrape your teeth, how did you feel while listening to music?

| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |
|---|---|---|---|---|

3.) What was your level of anxiety in relation to the sound or feel of scraping during teeth cleaning while listening to music?

| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |
|---|---|---|---|---|

4.) Did you learn today that you will need a dental procedure (cavity filling, tooth extraction, etc.)?

| Yes ☐ | No ☐ |
|---|---|

5.) Do you usually listen to the type of music found on your CD?

| Yes ☐ | No ☐ |
|---|---|

6.) How familiar are you with the songs that were played on the CD?

| Recognized ***all*** of the songs ☐ | Recognized ***most*** of the songs ☐ | Recognized ***many*** of the songs ☐ | Recognized only a ***few*** of the songs ☐ | Recognized ***none*** of the songs ☐ |
|---|---|---|---|---|

7.) Did you at any time mute or turn down the music other than to hear/speak to the hygienist/doctor?

| Yes, muted ☐ | Yes, turned down ☐ | No ☐ |
|---|---|---|

**Appendix B**

# Appendix C

**Control Entry Survey**

1.) Indicate your age:

| | | | | | | |
|---|---|---|---|---|---|---|
| 18-24 ☐ | 25-34 ☐ | 35-44 ☐ | 45-54 ☐ | 55-64 ☐ | 65-74 ☐ | 75 and older ☐ |

2.) When you are waiting in the dentist's office for your turn in the chair, how do you feel?

| | | | | |
|---|---|---|---|---|
| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |

3.) Imagine you are in the dentist's chair about to have your teeth cleaned. While you are waiting and the hygienist is getting out the instruments which will be used to scrape your teeth, how do you feel?

| | | | | |
|---|---|---|---|---|
| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |

4.) What is your level of anxiety in relation to the sound or feel of scraping during teeth cleaning?

| | | | | |
|---|---|---|---|---|
| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |

5.) Will you be having another dental procedure today after your cleaning?

| | |
|---|---|
| Yes ☐ | No ☐ |

6.) Which of these music genres do you most often listen to?

| | | | |
|---|---|---|---|
| Classical ☐ | Jazz ☐ | Pop ☐ | None of these ☐ |

# Appendix D

**Control Exit Survey**

1.) When you were in the dentist's chair having your teeth cleaned, how did you feel?

| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |
|---|---|---|---|---|

2.) While you were waiting and the hygienist was getting out the instruments which would be used to scrape your teeth, how did you feel?

| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |
|---|---|---|---|---|

3.) What was your level of anxiety in relation to the sound or feel of scraping during teeth cleaning?

| Relaxed ☐ | A Little Uneasy ☐ | Tense ☐ | Anxious ☐ | Very Anxious ☐ |
|---|---|---|---|---|

4.) Did you learn today that you will need a dental procedure (cavity filling, tooth extraction, etc.)?

| Yes ☐ | No ☐ |
|---|---|

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